Figure 1
WCT Symbols in Flow Diagrams and in Figures 1 through 23A

Symbol	Description	Notes
		CE can be any combustion design as is known in the
Combustion Engine (CE)	Combustion Engine	art, i.e. internal combustion engine, turbine, furnace, etc. CE combines fuel and ignites fuel with a spark generation device. Fuel is most preferably O ₂ , H ₂ and H ₂ O. Fuel is preferably O ₂ and H ₂ . Fuel can be used in combination with air.
	Gas Compressor	Used in Cryogenic Refrigeration. Designs are plentiful in the art. Compressor symbols: A = Air, D1 = First Distillation, D2 = Second Distillation, O1 = O ₂ , H1 = H ₂ , O = O ₂ Storage and H = H ₂ Storage.
<u> </u>	Joule-Thompson	Two types are normally used in the art –
	Expansion Valve	1. An expansion valve, 2. A cylinder.
	Separation (Distillation Column)	Diameter and Height dependent upon separation efficiency and loading. Separation efficiency dependent upon compounds separated and column packing. Distillation Temperatures are relative to Separation Operating Pressure. Depending on the desired O ₂ purity, the second O ₂ /N ₂ separation column is optional.
	Heat Exchanger to	During normal operation, it is preferred that the waste
Q X'fer	cool compressed	N ₂ is coolant. Depending upon design, upon start-up
	gases	water may be necessary for an efficient start-up.
	Cryogenic Storage Tank	Tank is to be made of materials known in the art to withstand liquid cryogenic temperatures/pressure of O ₂ and/or H ₂ . Tank may have refrigeration loop per Figure 13, which operates of off at least one of: the combustion engine, a battery and a fuel cell.
- + T	Turbine	Depending upon application, turbine is to be turned by steam, air or water movement. Turbine is preferred to generate electricity, preferably driving a generator and/or alternator. It is most preferred that the electricity performs electrolysis.
PC	Pressure Controller	Pressure controller can be of any design as is known in the art. PC protects downstream equipment from pressure surges. In high pressure surge situations, PC vents to the atmosphere.
Q	Energy in the form of heat	Energy is transferred (managed) during many methods, processes and systems of this invention.
C O N T	Fuel Mixture Controller	H ₂ , O ₂ , H ₂ O, air bypass and engine coolant. Controller manages fuel mixture ratios. H ₂ O ratio in combustion is managed depending upon combustion temperature and/or engine temperature. Air bypass is to be managed depending upon O ₂ tank level. Engine coolant loop dependant on high engine temperature.

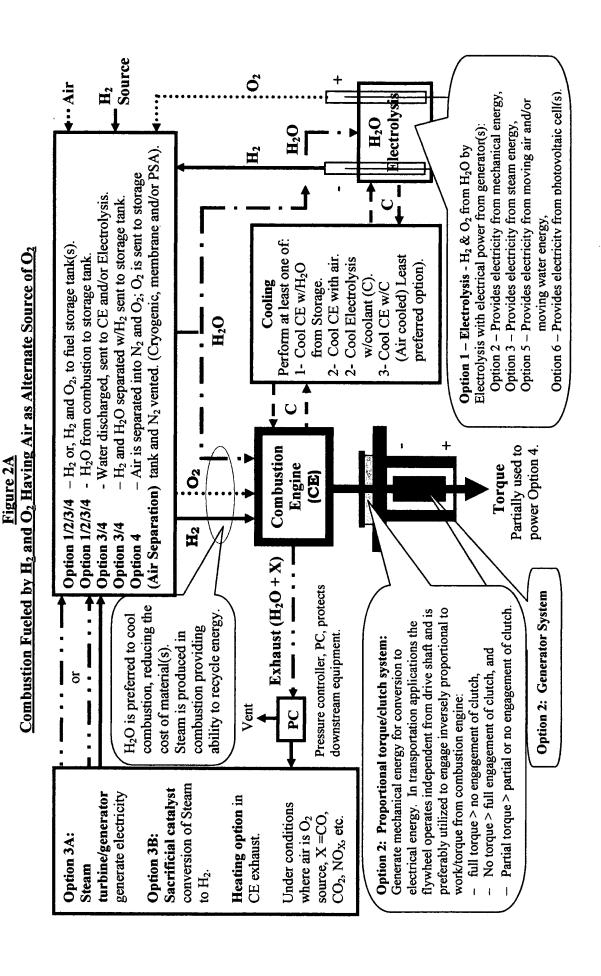
Figure 1A
WCT Symbols in Flow Diagrams and in Figures 1 through 23A

Symbol	Description	Notes
	Clutch	Used to transfer E _W to at least one of a flywheel and a generator. Clutch preferably engages during periods of little to no work and disengaged during periods of work. Design and assembly to be as known in the art.
	Flywheel	Used to store rotational kinetic energy during periods of little to no work; rotational energy to be utilized during periods of work.
+	Generator	Used to generate electrical energy. Generator can be of the type to generate an alternating current (A/C), such as in power generation applications or a Dynamo to generate a direct current (D/C) to power electrolysis. A/C current can be turned into D/C with an A/C to D/C converter and D/C can be turned into A/C with a D/C to A/C converter.
- H ₂ O Electrolysis	Electrolysis	Electrolysis of H ₂ O to O ₂ and H ₂ is to be performed. Electrolysis is to be performed by methods and systems known in the art of electrolysis. It is most preferred that an electrolyte be present in the H2O to further electrolysis and the efficiency of electrolysis. It is preferred that the electrolysis unit be cooled.
	Air Line	Line primarily contains air.
•••••	O ₂ Line	Line primarily contains O ₂ .
	N ₂ Line	Line primarily contains N ₂ .
	H ₂ Line	Line primarily contains H ₂ .
	H₂O Line	Line primarily contains H ₂ O.
	Products Line	Line primarily contains combustion products, preferably H ₂ O, yet can be H ₂ O and X, wherein X is N ₂ , CO _X and NO _X and can contain SO _X .
	Coolant (C) Line	Line symbol indicates flow of coolant, which is preferably used with electrolysis. C can be used with CE; however this is not preferred. C can be any type as is known in the art; coolant is preferred a mixture of water, glycol, corrosion inhibitor and dispersant.
	Control Line	Electrical or pneumatic line. Electrical wire carrying a small current, preferably 4 to 20 mA. Pneumatic line may carry a gas and/or a liquid under pressure.
	Flow Transmitter	Used in combination with control line and controller
	& Control Valve	(CONT.) to control flow of fuel and/or coolant (C)
+ <u>Q</u> ===3	Coolant Radiator	Used to release heat from coolant and pump back to heat source. Preferably used for electrolysis. Preferably used to cool oil for CE. It is not preferred to cool CE.

- Cool Air **→** Hot Air $E_F=E_W+\approx\!\!80\%$ E_F in energy losses for internal CE(s). $E_F=E_W+\approx\!\!35\%~E_F+\approx\!\!35\%~E_F+\approx\!\!9\%~E_F+\approx\!\!1\%~E_F$ (Turbines are less efficient; however, turbines with CE losses are from combustion Turns potential energy of fuel, steam generation reduce Ec and increase Eex: Coolant losses ≈ 30 to 40 % of E_F, into combustion energy. efficiency losses, CE, and Cool CE w/ coolant (C) $E_{fric} \approx 8$ to 11 % of E_F . $E_F = E_W + \approx 60-80\%$ E_F in energy losses. Combustion Engine combustion energy, Ec. friction losses, Efric. Traditional Combustion - Combustion Fueled by Hydrocarbon(s) and Air Coolant $C_E \leq 2 \ \% \ of \ E_F$ $E_F = E_W + E_{EX} + E_C + E_{fric} + C_E$ 101 Available for Work, Ew. **Torque Energy** Combustion Figure 2 Engine (CE) Hydrocarbon Storage or Source, Hydrocarbon(s) Potential Energy of Fuel, EF Exhaust: H₂O, CO_X, NO_x and potentially losses ≈ 30 to 40 % Source of O₂ Exhaust Energy of combustion energy, EEX. Air turbocharge **Emissions** preheat or System(s) Option(s): Vent Control

Mechanical energy losses during periods of low to

zero work.



4 of 28

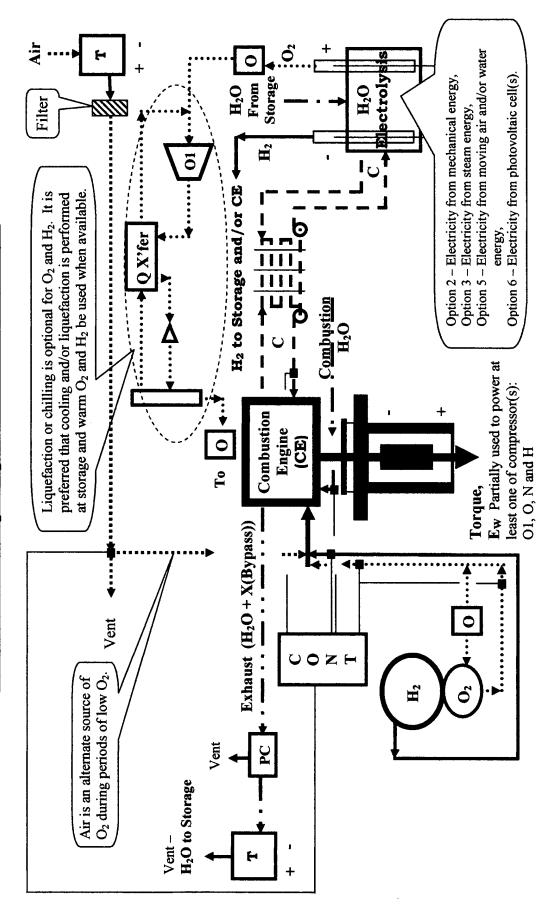


Figure 3 Combustion Fueled by H₂ and O₂ with Air as Alternate— Electrolysis

Combustion Fueled by H₂ and O₂ with Air as Alternate – H₂ Catalysis

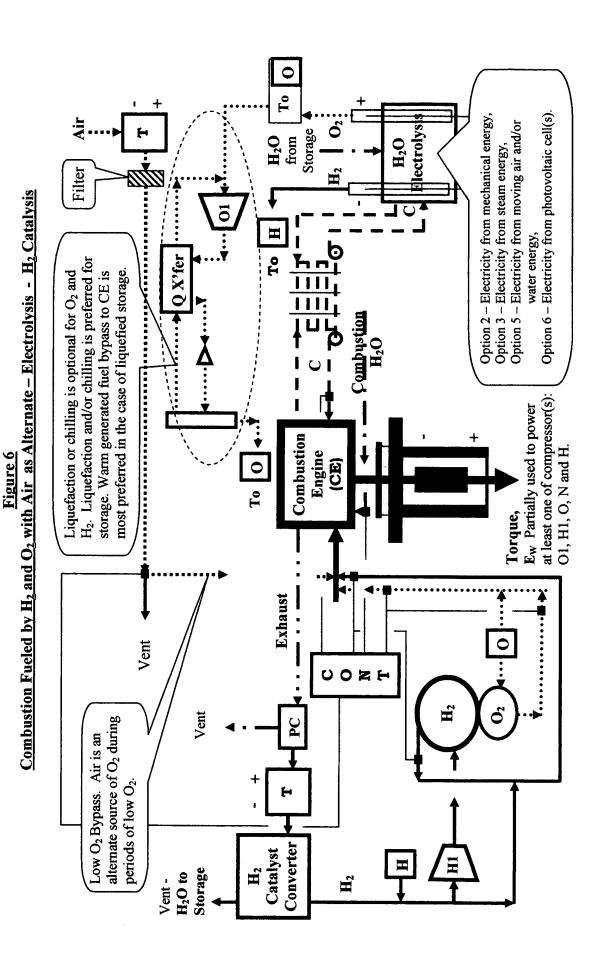
Figure 4

.. Air ****** Filter Air is an alternate source of O₂ during periods of low O₂. Combustion H₂O power at least one Combustion of compressor(s): H1, O, N and H. Torque, Ew Partially used to Engine (公区) O₂ Bypass Exhaust (H2O +X (Bypass)) Vent OOZE 0 Vent Converter Catalyst Vent \mathbf{H}_2

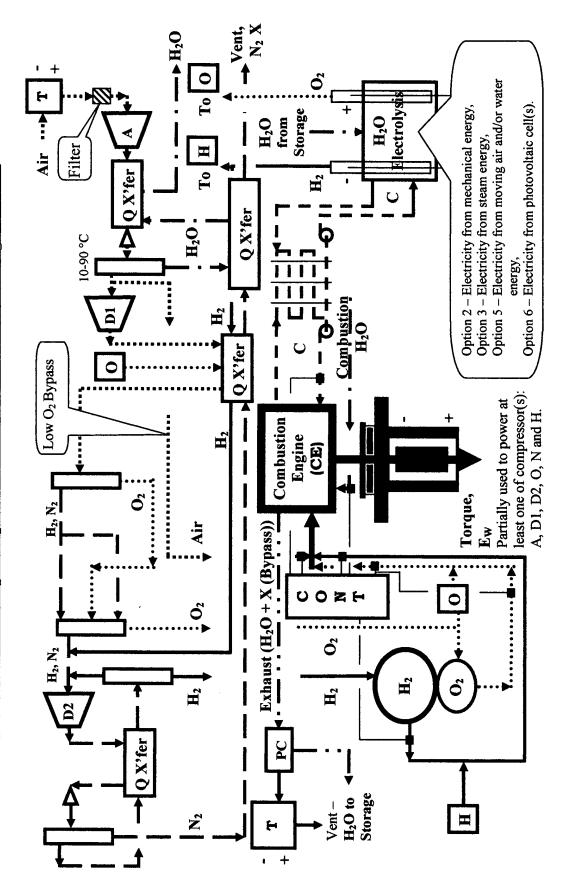
6 of 28

Vent, N₂/X Filter - ► H₂0 Q X'fer , H₂O 10-90 °C Low O₂ Bypass Combustion H₂O Q X'fer Partially used to power at least one of compressor(s): A D1, O, N and H. Torque, Ew Combustion Z Engine (CE) Ž Air Exhaust (H₂O + X (Bypass)) COME õ Õ Ž relative to Separation Operating Pressure. Temperatures are Distillation Vent

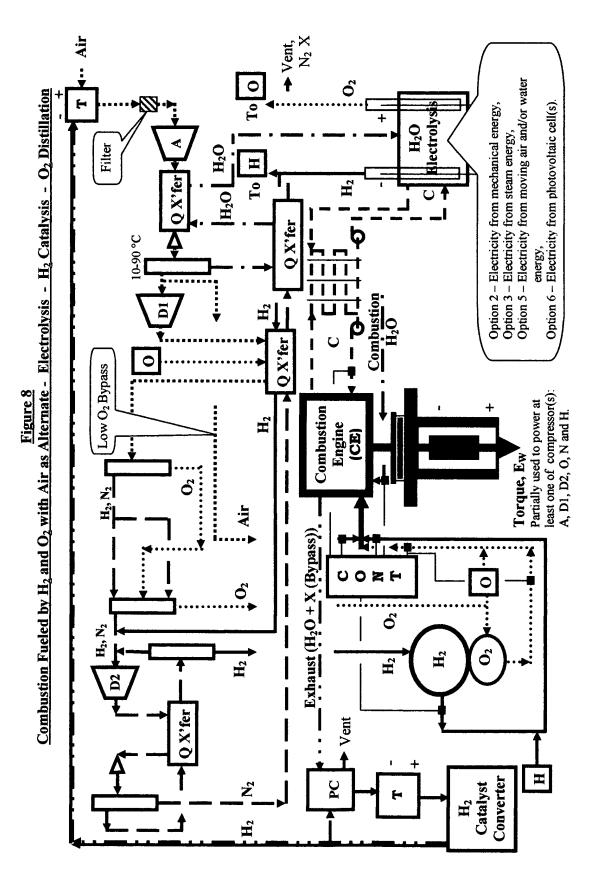
Figure 5
Combustion Fueled by H₂ and O₂ with Air as Alternate - O₂ Distillation



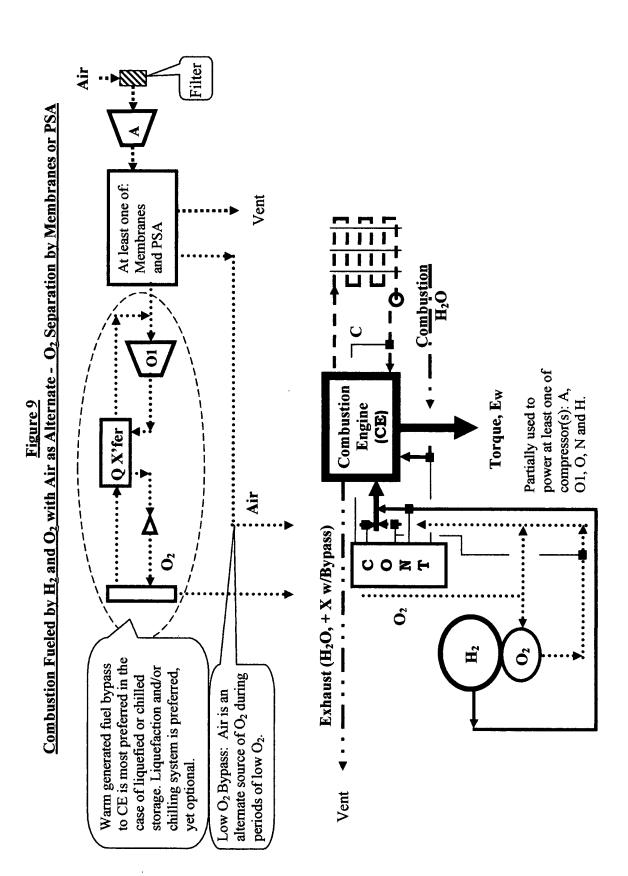
8 of 28

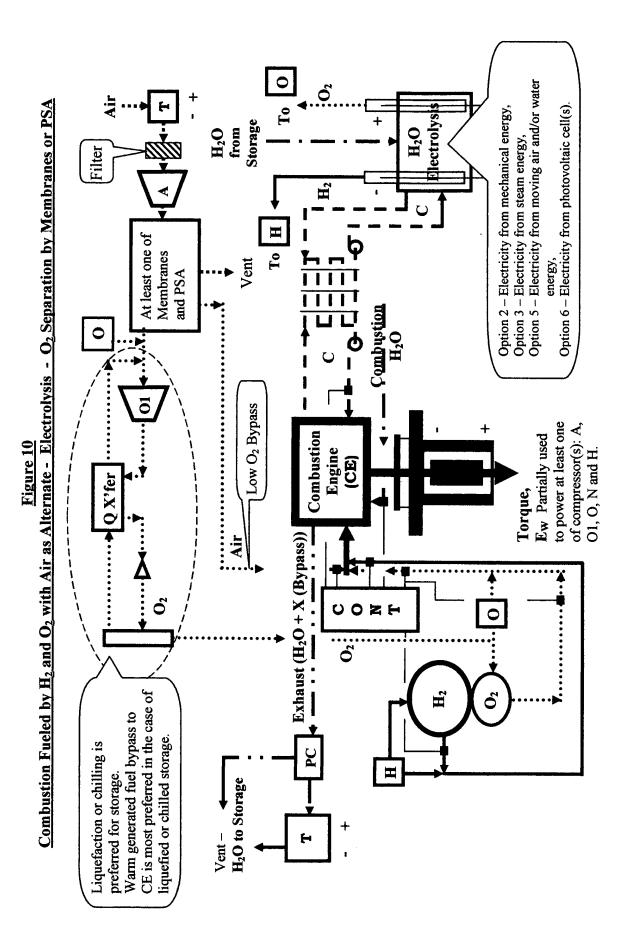


Combustion Fueled by H₂ and O₂ with Air as Alternate - Electrolysis - O₂ Distillation Figure 7

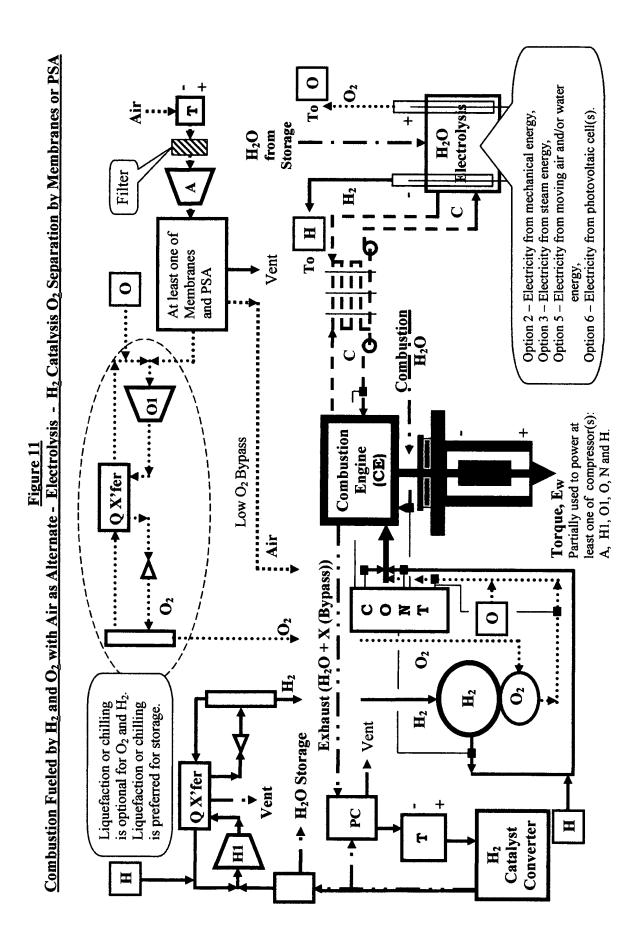


10 of 28

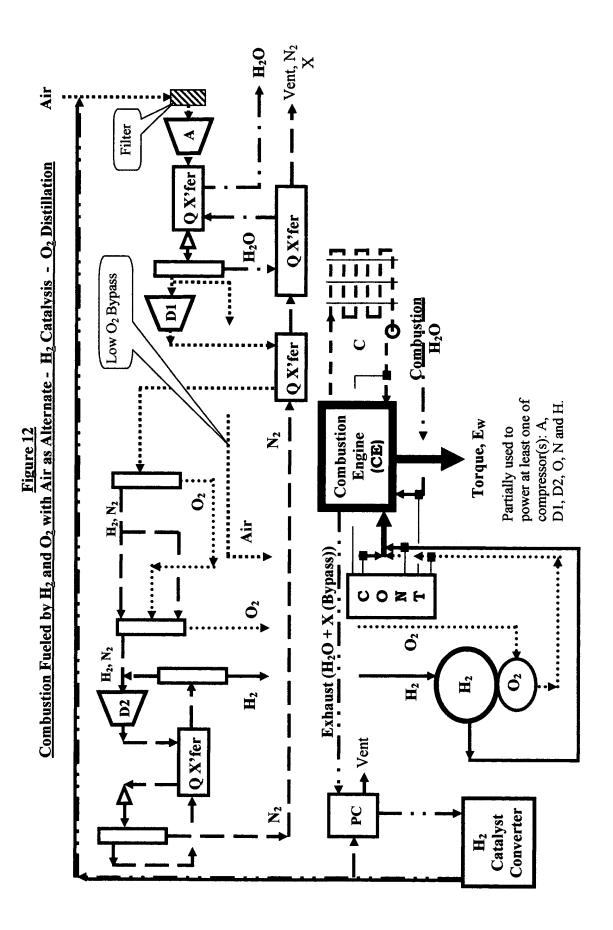




12 of 28



13 of 28

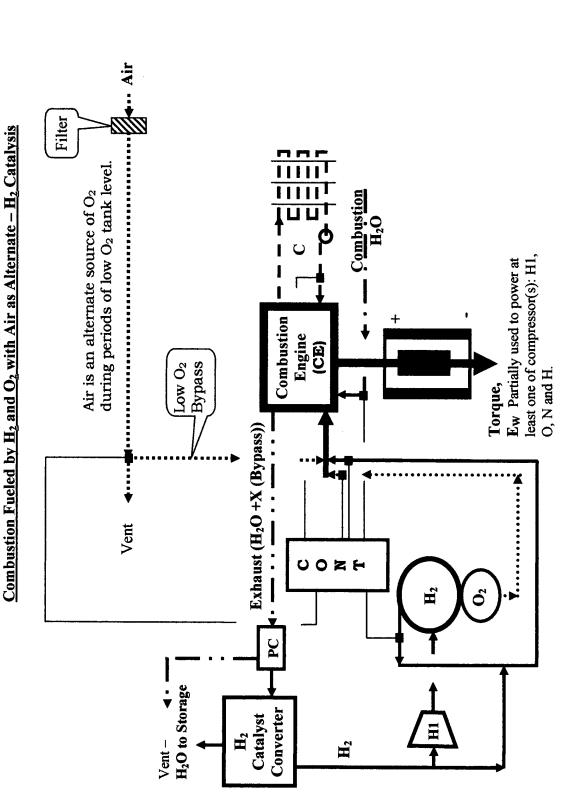


14 of 28

Air Air Combustion Fueled by H₂ and O₂ with Air as Alternate - H₂ Catalysis O₂ Separation by Membranes or PSA Filter Vent At least one of Membranes and PSA Combustion H₂O Low O₂ By-pass manade for the second s power at least one of compressor(s): A, H1, O1, O, N and H. Combustion Torque, Ew Partially used to Engine (CE) O X'fer Air Exhaust $(H_2O + X (Bypass))$. OOZH 0 0 $[H_2]$ Liquefaction or chilling is optional chilling is preferred for storage. for O₂ and H₂. Liquefaction or H_2 ► H₂O Storage Q X'fer Vent Vent PC Converter Catalyst

Figure 13

Figure 14

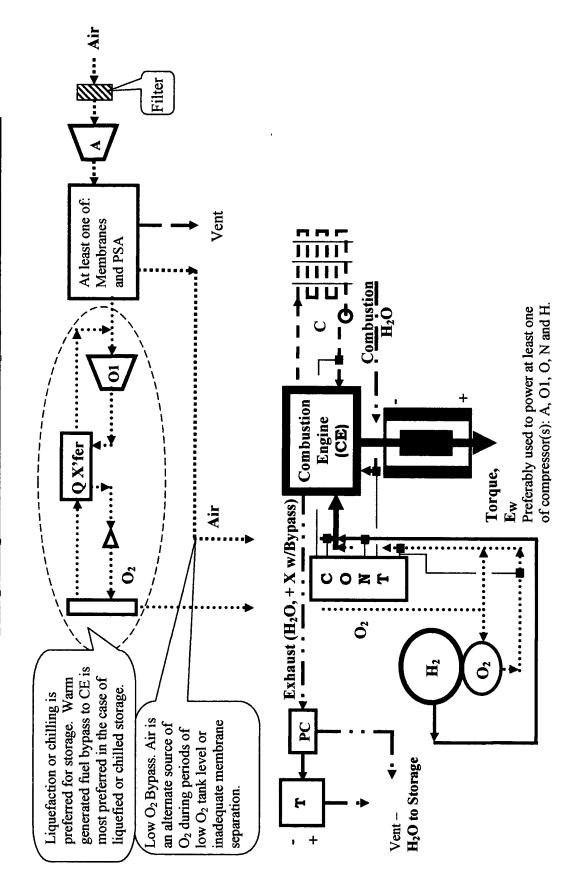


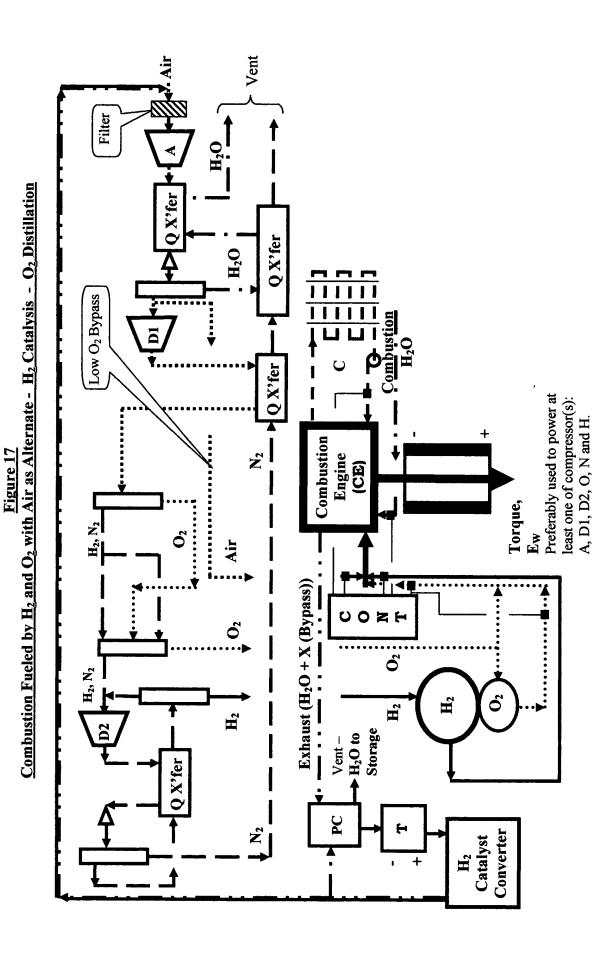
16 of 28

Vent N₂ and X H₂0 Filter O X'fer Q X'fer H₂0 J. 06-01 Low O₂ Bypass Preferably used to power at least one of compressor(s). A, D1, O, N and H. O X'fer Combustion Engine (CE) Z Torque, Õ Z Exhaust $(H_2O + X (Bypass))$ Air COME Õ 0 Ž relative to Separation Operating Pressure. Temperatures are Distillation PC H₂O to Storage Vent -

 $\frac{Figure\ 15}{Combustion\ Fueled\ by\ H_2\ and\ O_2\ with\ Air\ as\ Alternate\ -\ O_2\ Distillation}$

Combustion Fueled by H₂ and O₂ with Air as Alternate - O₂ Separation by Membranes or PSA Figure 16



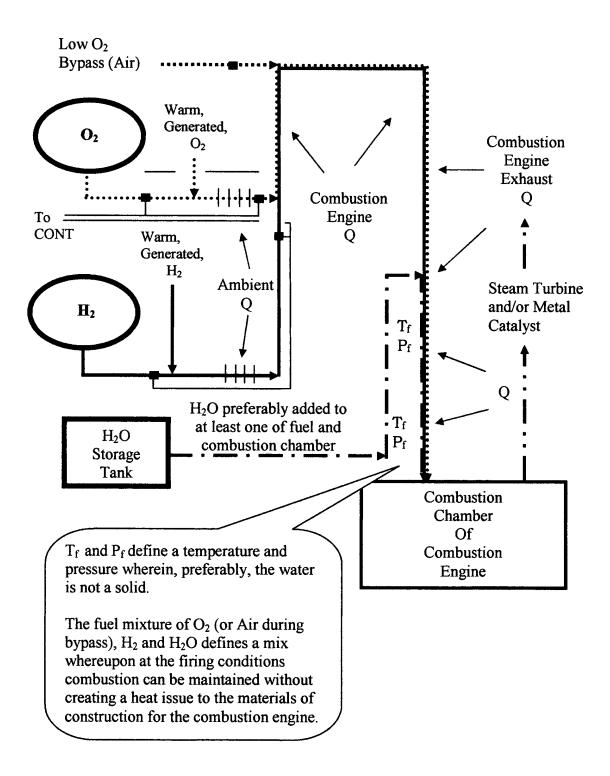


19 of 28

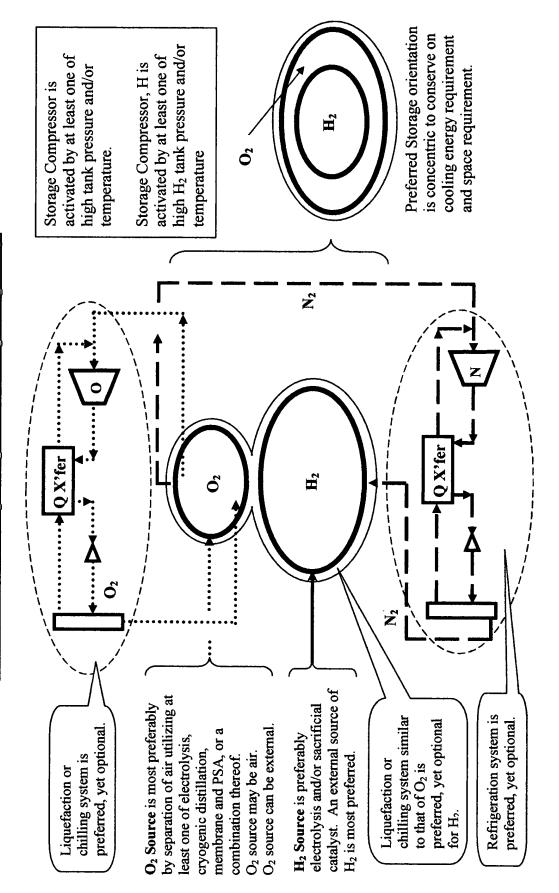
Filter Combustion Fueled by H₂ and O₂ with Air as Alternate - H₂ Catalysis O₂ Separation by Membranes or PSA Vent At least one of Membranes and PSA Low O₂ By-pass Partially used to power at least A, H1, O1, O, N and H. one of compressor(s): Torque, Ew Combustion Figure 18 Engine (CE) 0 Q X'fer Air Exhaust $(H_2O + X (Bypass))$ COZH 0 0 bypass to CE is most preferred in the Liquefaction or chilling is preferred case of liquefied or chilled storage. for storage. Warm generated fuel \mathbf{H}_2 Storage Vent – ►H₂O to ► H₂O Storage O X'fer Vent PC Converter Catalyst \mathbf{H}_2

20 of 28

Figure 19
Combustion Fueled by H₂ and O₂ and/or Air - Fuel Preheating



 $\frac{\text{Figure } 20}{\text{Combustion Fueled by H}_2 \text{ and } O_2 \text{ and/or Air - } O_2 \text{ and H}_2 \text{ Storage}}$





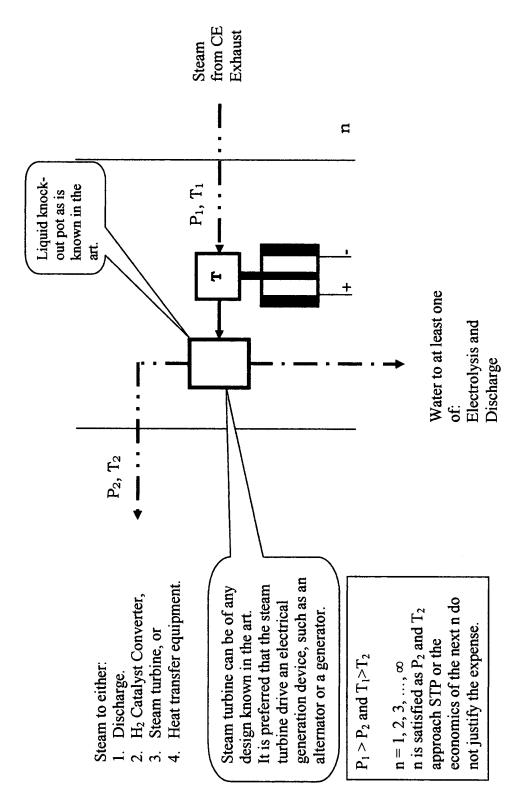


Figure 21A
In-Line Combustion and Steam Turbine Configuration(s)

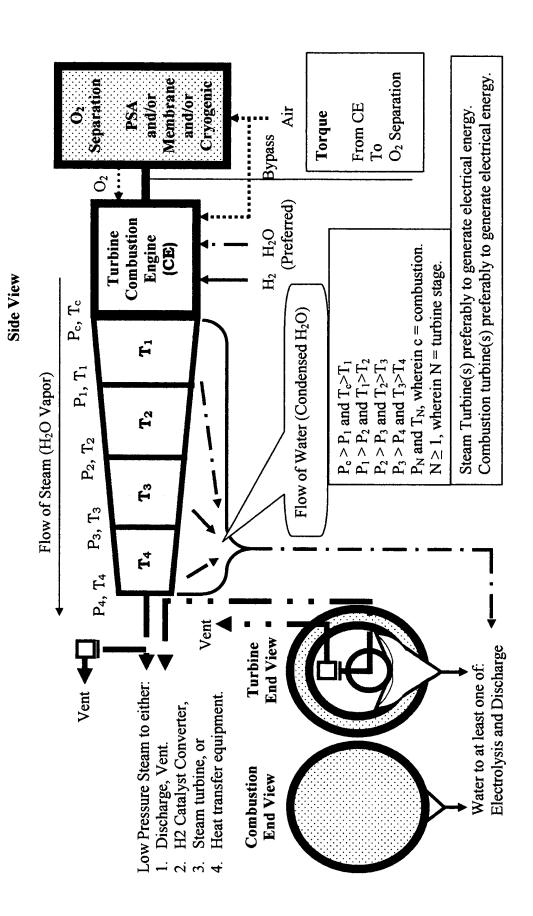
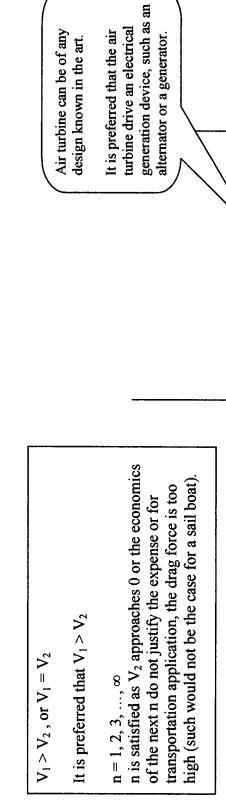


Figure 22 Air Movement Turbine Configuration(s)



Air to at least one of:

1. Discharge.
2. Filter and Distillation,
3. Filter and membrane.
4. Filter and membrane.

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Drag force due to air turbine

Moving

 \bigvee_1

 V_2

Air

Figure 23
Horizontal Water Movement Turbine Configuration(s)

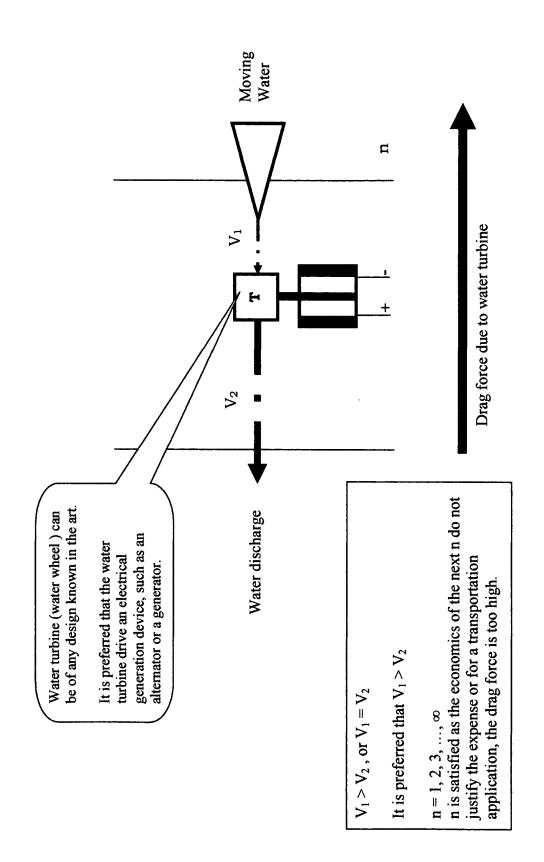


Figure 23A
Vertical Water Movement Turbine Configuration(s)

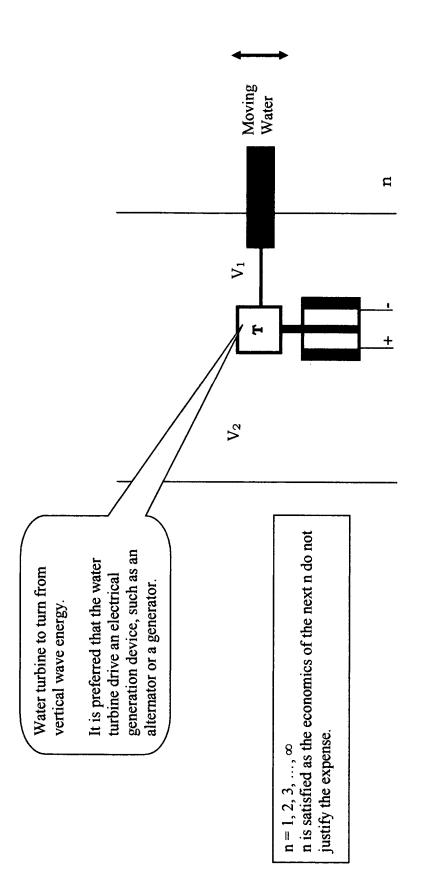


Figure 24
Pressure Control Configuration(s)

